

## Assignment 3

Textbook Assignment: "Atmospheric Circulation"; "Air Masses and Fronts."  
Pages: 3-1-1 through 4-2-13.

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Learning Objective: Determine the conditions necessary for the formation of air masses, identify air mass source regions, and differentiate between air mass classifications within and outside of their source regions.

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- 3-1. What two factors are necessary to produce an air mass?
1. Anticyclonic circulation and non-homogeneous properties of temperature, lapse rate and moisture
  2. Large divergent flow and a widespread body of relatively uniform air
  3. Uniform surface and relative humidity
  4. Moisture and heat
- 3-2. Why are anticyclonic circulations most favorable for air mass development?
1. The horizontal outflow of air affects a much larger area
  2. The air moves slowly or is stagnant, making it easier for the air to assume the characteristics of the underlying surface
  3. The subsidence associated with these circulations is favorable for lateral mixing, thereby bringing about horizontal homogeneity
  4. All of the above are reasons
- 3-3. The properties an air mass acquires in its source region are dependent on a number of factors. Which of the following is NOT a factor in determining air mass properties?
1. Time of year
  2. Type of surface (land, water, ice)
  3. Length of time the air mass remains over the region
  4. Circulation pattern
- 3-4. Which air mass has its source region between 10°N lat. and 10°S lat.?
1. T
  2. A
  3. P
  4. E
- 3-5. Monsoon air is REALLY one of two air masses depending on the time of year. Which two air masses make up monsoon air?
1. cP and mT
  2. cP and E
  3. mP and E
  4. mP and mT
- 3-6. On what factors are air mass classifications based?
1. Temperature, humidity, and wind
  2. Season, latitude, and source region
  3. Geographic origin, moisture content, and thermodynamic process
  4. Geographic origin, temperature, and humidity
- 3-7. A cP air mass moves south out of its source region in Canada and invades the south central U.S. How would this air mass most likely be classified thermodynamically?
1. Moist (m)
  2. Cold (k)
  3. Warm (w)
  4. cool (c)
- 3-8. How is the stability of an air mass affected, if at all, when it leaves its source region?
1. It is increased only
  2. It is decreased only
  3. It may be increased or decreased
  4. It is not affected

- 3-9. It is February, and a very cold continental polar air mass pushes south over tropical waters. Which, if any, of the following changes is most likely to occur within the air mass?
1. A decrease in water vapor content takes place
  2. The lower layers are cooled by conduction
  3. An increase in stability occurs
  4. None of the above
- 3-10. Air mass stability can be changed thermodynamically or mechanically.
1. True
  2. False
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- Learning Objective: Describe the trajectories and weather associated with the air masses that influence North America.
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- 3-11. Over the midlatitudes of North America in winter, an air mass exhibiting surface temperatures of  $-18^{\circ}\text{C}$  or colder is generally classified as
1. cPk
  2. mPk
  3. cAk
  4. cPw
- 3-12. Much can be gained from knowing the path cP and CA air masses take on leaving their source regions in North America. Which of the following statements pertains to the winter outbreaks of these air masses when their path is cyclonic?
1. Good flying conditions are the rule
  2. Cloud cover lingers along the Atlantic coast until the air mass clears the Appalachian mountains
  3. Frequent and widespread snow squalls can be expected on the leeward side of the Great Lakes
  4. Unrestricted visibilities are common on the windward side of the Appalachian mountains
- 3-13. Weather along the U.S. west coast in winter is predominantly the result of which air mass?
1. mP
  2. cP
  3. cA
  4. mT
- 3-14. What air mass is generally responsible for relatively mild weather across the U.S. in winter, and is often incorrectly referred to as mT?
1. cP with a short cyclonic trajectory over the Pacific
  2. cP with a long cyclonic trajectory over the Pacific
  3. mP with an anticyclonic trajectory along the northern border of the Pacific high
  4. Highly modified equatorial (E) air
- 3-15. The heaviest precipitation recorded in Southern California in winter is produced from what air mass?
1. mP
  2. cP
  3. mT
  4. cT
- 3-16. Maritime polar (mP) air is far more frequent along the west coast of the U.S. than the east coast. Why?
1. mP air of the Atlantic and Pacific are both more apt to move in an easterly direction, and in the Atlantic, this movement takes mP air away of the U.S. east coast
  2. cP air is heavier and more dense than mP air, and it acts as a barrier over North America
  3. The Greenland ice cap blocks mP air from moving west to the North American continent (U.S. east coast)
  4. The very warm water temperatures of the Gulf Stream rapidly modify mP air requiring it to be reclassified as mT air
- 3-17. After a week of colder than average temperatures, the southeastern U.S. comes under the influence of much warmer mT air over the Gulf of Mexico. Which of the following types of weather will likely be produced by the mT air?
1. Snow flurries
  2. Thunderstorms and tornadoes
  3. Widespread advection fog
  4. Copious rain
- 3-18. True mT air does not have dewpoint temperatures below what value?
1.  $60^{\circ}\text{F}$
  2.  $65^{\circ}\text{F}$
  3.  $70^{\circ}\text{F}$
  4.  $75^{\circ}\text{F}$

3-19. Which of the following air masses dominates most of the U.S. during the summer season?

1. mT or cP
2. mT or mP
3. mT or S
4. E or mP

3-20. Which of the following air masses dominates the U.S. Pacific coast during summer?

1. mT
2. mP
3. cP
4. S

3-21. In summer, east of the Rocky Mountains, mP air and cP air exhibit the same properties.

1. True
2. False

3-22. When mT air moves north over the Grand Banks area of Newfoundland in summer, which of the following types of weather is most likely to occur?

1. Fog
2. Heavy rain
3. Convective thunderstorms
4. Mechanical thunderstorms

3-23. Which of the following air masses is NOT found over the North American continent during winter?

1. cT
2. S
3. mT
4. cPk

3-24. Which of the following statements concerning superior air is correct?

1. It is found in the northwest U.S.
2. It is an exceptionally moist air mass
3. It is rarely found at the surface
4. Each of the above

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Learning Objective: Describe the air masses of Asia, Europe, and the Southern Hemisphere.

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3-25. In winter, Japan's weather is primarily influenced by which of the following air masses?

1. cP
2. mT
3. mP
4. cT

3-26. The summer monsoon of India and Burma is the result of what air mass?

1. mT
2. cP
3. mP
4. E

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IN ANSWERING QUESTIONS 3-27 THROUGH 3-30 SELECT FROM COLUMN B THE AIR MASS THAT IS DESCRIBED IN COLUMN A.

	A. DESCRIPTIVE PHRASES	B. SUMMER AIR MASSES OF EUROPE
3-27.	Modifies rapidly on leaving its source region and is reclassified as mP air	1. cA/cP 2. mA 3. mT 4. cT
3-28.	Dry air that normally brings fair weather to the British Isles and the European continent	
3-29.	Air mass is warm, dry, and unstable in its source region	
3-30.	Visibility in this air mass is better in summer than in winter	
3-31.	In winter, Great Britain occasionally experiences the effects of cA and cP air. Where do these air masses originate?	1. Iceland 2. North America 3. Greenland and Spitsbergen 4. Siberia, Finland and Lapland

IN ANSWERING QUESTIONS 3-32 THROUGH 3-35, MATCH THE AIR MASS IN COLUMN B WITH THE DESCRIPTIVE PHRASE IN COLUMN A.

A. DESCRIPTIVE PHRASES	B. WINTER AIR MASSES OF EUROPE
3-32. Usually follows a cyclonic path into Europe	1. cA/cP
3-33. Usually originates over North America	2. mP
3-34. Outbreaks often lead to cyclogenesis in the Mediterranean	3. mT
3-35. Fog and drizzle are common with this warm, very moist air mass	4. mA
3-36. Which of the following air masses originates over the Atlantic Ocean but moves over land and is classified as a continental air mass?	
1. cP	
2. cT	
3. cA	
4. S	
3-37. Australian weather is dominated by cT air; however, mT air is more of a factor along one of its four coasts. Which coast is most affected by mT air?	
1. East	
2. West	
3. North	
4. South	
3-38. Which of the following air masses is the coldest on record and where is it found?	
1. cP - North America	
2. cA - Arctic	
3. cA - Antarctica	
4. mP - Weddell Sea	
3-39. In the Southern Hemisphere, which of the following air masses is the most important in providing relief from the oppressive summer heat?	
1. cP	
2. cA	
3. mP	
4. mA	

Learning Objective: Define, describe, and classify fronts.

- 3-40. What is a front?
1. A boundary between two air masses
  2. A zone of transition between two adjacent air masses bounded by a frontal surface
  3. A zone of transition between two air masses of different densities
  4. A point where two air masses touch
- 3-41. What determines frontal classification?
1. Density differences
  2. Temperature differences
  3. Frontal movement
  4. Involved air masses
- 3-42. What classification is given to the front that separates a warm air mass from a retreating mass of cold air?
1. Warm
  2. Cold
  3. Quasi-stationary
  4. Occluded
- 3-43. What are the primary frontal zones in the Northern Hemisphere?
1. Polar and tropical
  2. Polar and arctic
  3. Arctic and tropical
  4. Polar and equatorial
- 3-44. Cold air being heavier than warm air will either under run the warm air or be overrun by warm air.
1. True
  2. False
- 3-45. Which of the following statements refer(s) to frontal slope?
1. A front's position along the Earth's surface
  2. The zone of discontinuity between air masses
  3. The ratio of a frontal surface's elevation to horizontal extent
  4. All of the above

3-46. Which of the following statements concerning the relationship between fronts and cyclones (low-pressure centers) is correct?

1. All surface fronts develop a closed cyclonic circulation at the surface and aloft
2. Upper-level cyclones that lower to the Earth's surface always contain fronts
3. Every front is associated with a cyclone and travels with it
4. Fronts can occur anywhere but cyclones cannot

3-47. What is the average speed of wave cyclones along the polar front?

1. 10 - 15 knots
2. 15 - 20 knots
3. 20 - 25 knots
4. 25 - 30 knots

3-48. When is a frontal wave most intense?

1. When a cyclonic circulation develops
2. When a cyclonic circulation causes the cold air to overtake the warm air and forms an occlusion
3. When the pressure in the wave cyclone begins to lower
4. When the pressure in the wave cyclone reaches its lowest point

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Learning Objective: Describe the conditions necessary for frontogenesis and frontolysis, and identify frontogenetical zones.

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3-49. When two air masses having different densities are brought together by the prevailing wind field, what takes place?

1. A front forms
2. There's a decrease in the temperature gradient
3. The wind flow parallels the isotherms
4. Each of the above

3-50. What is cross-isothermal flow?

1. The flow of wind across isobars
2. The flow of wind across isotherms
3. The flow of wind across fronts
4. A col

3-51. Frontogenesis is most likely to occur where there is a concentration of isotherms and a circulation that sustains the concentration.

1. True
2. False

3-52. Which of the following statements concerning frontolytical processes is correct?

1. They are most effective in the lower layers of the atmosphere
2. They are more common than frontogenetical processes
3. They bring about frontal dissipation
4. Each of the above

3-53. During summer in the Northern Hemisphere, where would you most likely find the Arctic front?

1. In the North Atlantic
2. In the North Pacific
3. North of Europe
4. Northeastern Asia

3-54. Which of the following statements concerning polar fronts is correct?

1. They separate polar air from tropical air only
2. They are stronger in summer than winter
3. They are more common along eastern coasts of continents in summer
4. They are present throughout the year

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Learning Objective: Describe frontal elements and general characteristics of fronts.

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3-55. What three elements are used to determine whether or not a front actually exists?

1. Visibility, temperature, and pressure
2. Clouds, temperature, and wind
3. Temperature, pressure, and wind
4. Present weather, temperature, and pressure

3-56. The temperature increase within a frontal inversion and the thickness of the inversion layer provide a rough indication of

1. frontal slope
2. frontal intensity
3. turbulent mixing
4. precipitation within a frontal zone

- 3-57. Which of the following statements concerning frontal inversions is correct?
1. Cold fronts generally show stronger inversions than warm fronts
  2. They normally show up as a decrease in the lapse rate below 400 millibars
  3. Double inversions are often evident with occluded fronts
  4. 'Each of the above
- 3-58. Which of the following occurrences causes a front to exhibit a strong inversion layer and little or no weather activity?
1. Subsidence in the warm air above the frontal surface
  2. Subsidence in the cold air beneath the frontal surface
  3. Adiabatic warming of the cold air beneath the frontal surface
  4. Upward vertical motion in the warm air
- 3-59. In the Northern Hemisphere when a front passes your station, what change takes place in the wind direction?
1. It veers
  2. It backs
  3. It shifts in a counterclockwise direction
- 3-60. In a frontal zone, what, if anything, normally happens to the wind speeds?
1. They increase with height only
  2. They decrease with height only
  3. They may increase or decrease with height
  4. They vary on either side of the frontal zone, but maintain a steady state through the zone
- 3-61. At the surface, when a front moves beyond its associated pressure trough, how, if at all, are the winds across the front affected?
1. The wind speeds do not change, but the wind shift becomes far more apparent
  2. The wind speeds show a drastic change, and the wind shift becomes far more apparent
  3. The wind speed difference across the front continues, but the wind shift can become almost undetectable
  4. Movement out of the pressure trough affects neither wind speeds or direction
- 3-62. Which of the following factors causes frontal. clouds, condensation, and weather?
1. Low pressure
  2. Friction between front and Earth's surface
  3. Vertical displacement of air along the front
  4. Each of the above
- 3-63. Which of the following frontal slopes is classified as being the steepest?
1. 1:35
  2. 1:50
  3. 1:150
  4. 1:300
- 3-64. What factor(s) contribute(s) to a steep frontal slope?
1. High wind velocity difference across the front
  2. Small temperature contrast across the front
  3. High latitude
  4. All of the above
- 3-65. In the warm air ahead of a cold front, the temperatures average 82°F/28°C. In the cold air 100 miles to the rear of the cold front, the temperatures average 64°F/18°C. What is the front's intensity based on temperature gradient?
1. Very weak
  2. Weak
  3. Moderate
  4. Strong
- 3-66. Frontal movement is determined by the
1. temperature gradient behind the front
  2. pressure difference across the front
  3. wind speed component ahead of the front
  4. wind velocity component behind the front